Results.– Collected data showed big variety of lower limb rotational deformities, are multilevel localised in same direction or, more frequently, in opposite directions. Nevertheless, more frequent patterns were identifying. Foot progression angle is internal in 61% of the case, neutral in 18% of the cases and external in 21% of the cases. Pelvic rotation is internal in 41% of the cases, neutral in 32% of the cases and external in 27% of the cases. Hip rotation is internal in 29% of the cases, neutral in 44% of the cases and external in 27% of the cases. Ankle rotation is internal in 55% of the cases, neutral in 29% of the cases and external in 16% of the cases.
Discussion.– Lower limb rotational troubles are often localised on many levels and are in opposite directions for 46% of the cases. Pelvic rotational troubles as single cause of abnormal foot progression angle represents 17% of the cases and cannot be revealed by physical examination. The ignorance of it can lead to inadequate therapeutic decision. Internal ankle rotation represents 29% of single cause of abnormal foot progression angle. The study could not revealed a classification as in sagittal plane. Big variety of associated lower limb torsional troubles by a same CP child need kinematic for identification of all troubles. Three-dimensional gait analysis data associated with physical examination is essential to find causes of lower limb rotational troubles (torsional bone deformity, muscles spasticity, muscles contracture).

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Measurement of femoral torsion using the EOS system: Validity, reliability, and perspectives for children and adults with cerebral palsy

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Keywords: Femoral torsion; Stereoradiography; EOS; Cerebral palsy
Aims.– 2D CT is currently the standard method of measurement of femoral torsion despite limitations in terms of validity and reliability in the population of cerebral palsy. The stereo-radiography using the EOS system is a promising recent method in the field of the PMR for measuring bone deformities that allows 3D reconstruction of the entire skeleton of the lower limbs, standing up, from two orthogonal radiographs with a very low radiation exposure.
The objective of this study was to evaluate in vitro the concurrent validity of the two methods and intra and inter-observer reliability of the EOS system for the measurement of physiological and artificially modified femoral torsion.
Materials and methods.– Fifty dried femurs were scanned using a CT scan 2D (method of Reikeras [1]) and the EOS system. One observer performed twice the measurements using the EOS system and another once. The CT scan measurements were performed by an independent observer.
In order to reproduce the deformations of the femur of people with cerebral palsy, torsion of 10 femurs was artificially altered from −30°, 0°, 15°, 30°, 45° and 60°. New measures in each condition were performed using both CT Scan and EOS.
Results.– The mean difference between measurements in CT-Scan and EOS was between 1.97° and 2.46° (not significant). Both sets of measurements showed excellent correlation ($r = 0.92$). The intra and inter-observer reliability of the EOS measures were excellent (ICC = 0.98, SEM = 6.72° and ICC = 0.98, SEM = 6.88°, respectively). When anteversion was modified the two methods differed from 1.18° to 2.34° (not significant).
Conclusion.– These first in vitro metrological data, needed because of the double irradiation, incite to use the EOS system for measuring physiological and pathological femoral anteversion. An in vivo study is needed to confirm the limits of agreement of the measure in a population of people with cerebral palsy.

Reference

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Effect of walking speed on muscular co-activation in gait of children with hemiplegic cerebral palsy

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Keywords: Cerebral palsy; Dynamic electromyography; Co-activation; Spasticity
Background: Co-activation (CA) is defined as the simultaneous electrical activity of two antagonistic muscles. Excessive CA restrains the motion and increases energy expenditure. During gait, CA is increased by speed and by an upper motor neuron lesion. It is important, for treatment perspectives, to distinguish between pathological and compensatory muscular activation. The aim of this study was to exhibit the pathological component of CA in unilateral cerebral palsy (CP) children.
Methods.– Ten unilateral CP children and ten matched typically developing (TD) children were asked to walk at spontaneous, very slow and very fast speed. The spatio-temporal parameters and electromyographic activity of the rectus femoris (RF), vastus medialis (VM), semi-tendinosus (ST), tibialis anterior (TA) and soleus (SO) of both lower limbs were recorded. A CA index was computed according to Unnithan et al. [1]. A mixed linear model was used to assess the effect of walking speed on the CA index in the various limbs and muscle couples (RF/ST, VM/ST, TA/SO).
Findings.– A stronger impact of the walking speed on CA was found in the involved limbs of CP children, for the three muscle couples, than in their uninvolved limbs or in the limbs of TD children. The two latter had a similar impact of speed. There was a lesser increase of CA with speed in the RF/ST couple than in the VM/ST or TA/SO in TD children. This particularity was not found in CP children.
Interpretations.– A spastic component of muscular activation, due to the upper motor neuron lesion, might be responsible for the increase of CA with gait speed in the involved limb. Musculo-skeletal models could be used to identify the link between muscle stretch and activation. The specificity of the RF/ST couple, which is less impacted by speed in TD children, is lost in CP children, indicating poor motor control. Improved linear modeling and investigating the different phases of the gait cycle could help identify a specific motor behaviour (compensation) of the uninvolved limb.

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Evolution of the biomechanical and bioenergy parameters of the walking during a test of walking prolonged at the young cerebral palsy person

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